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# Ph.D. THESIS

## SMALL AND MEDIUM-SIZED ENTERPRISES IN CLOUD COMPUTING

(abstract)

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Iassy
2013

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**Keywords**: SME, cloud computing, cost, flexibility, adoption

In all current economies, the small and medium enterprises (SMEs) sector has become very important due to the growing significance that this type of organization has in economy. Studies led on SMEs are also supported by the contemporary tendency to abandon the idea of large companies in favour of their fragmentation into smaller units, close to the model of small and medium enterprises.

At present, the majority of small and medium-sized enterprises struggle, on the one hand, against the difficulties caused by the economic crisis, while on the other hand they try to keep pace with a highly competitive and demanding market. SMEs are constantly looking to discover new ways to reduce costs, as well as seeking business opportunities that would provide them with an advantage in their competition with other companies. The implementation of IT solutions may represent the starting point for both the reduction of costs and the creation of new opportunities. In addition, the mutual reliance between technology, business needs and economic factors has been the decisive factor that led to the emergence of cloud computing services. This recent technological phenomenon marks a new stage in the IT evolution and influences both the present and future dynamics of IT services as to the way in which small businesses will use information technology in their daily activities. In SMEs, cloud computing adoption promises a wide range of commercial and technical advantages, but one must also take into account the risks and the challenges that this change involves.

The emergence of cloud plays its part in determining many major changes within companies. The "early" adoption of these services may give enterprises the opportunity to transform their business model as a whole and so increase their productivity. Therefore, cost reduction is not the only reason that attracted the interest of many companies. Through the implementation of the cloud paradigm, companies are given the possibility to focus all their efforts on their primary activities and entrust other activities, such as the development or maintenance of the IT infrastructure, to cloud services providers. Moreover, through cloud adoption, SMEs

can become more responsive to changes that affect the markets on which they conduct their businesses, while the new way of managing the technology can help them optimally dose their resources in order to meet new business opportunities that they might lose otherwise.

Although the development of cloud services is a fairly new process, it has been found that in order to remain competitive, SMEs have already begun to adopt this type of services and the trend is growing. As a consequence, we believe that this is not a temporary phenomenon, but a reality that has just begun to show its potential.

## Research Delimitations

One of the starting points of this paper is that, although in many developed countries cloud computing has already begun to be massively adopted, there is a low level of usage of technologies like cloud computing among SMEs from Romania. Taking all this into consideration, one of the first issues we wish to consider is the identification of the current state of cloud computing adoption among SMEs. Another aspect we want to refer to concerns the multiple benefits that the implementation of cloud computing technologies brings within SMEs. Unlike large companies, SMEs use a simplified IT architecture that enables them to be more flexible. Typically, most SMEs do not have the human and financial resources to access the latest technologies, while cloud computing provides them with the opportunity to overcome this drawback.

Also, in most cases, cloud computing adoption can lead to significant cost reduction in the information systems management within SMEs. This major benefit can be doubled by other factors, specific to each company. In all cases, it is necessary to make a thorough analysis of these factors, which should lead to the selection of the optimal cloud computing solution for the business, as well as of the appropriate provider.

Therefore, taking all these preliminary observations into account, in this paper we approached the cloud computing services

from multiple points of view. One of them concerns the analysis of the level of cloud computing services development and promotion in Romania.

If we were to turn our attention to *the international environment*, then we should mention that, in addition to the numerous works dedicated to this field, cloud computing studies hold a special place inside representative organizations such as European Network and Information Security Agency (ENISA), Information Systems Audit and Control Association (ISACA) or Cloud Security Alliance. Also, in order to find out what is the level of services development in the world at a certain point, the reports issued by large research organizations on the evolution of information technologies (such as Gartner, IDC, KPMG, etc.) prove to be very useful.

Considering these aspects, in addition to presenting the current situation of the cloud phenomenon in Romania and suggesting some ways to promote this paradigm within organizations from our country, our research also makes a thorough analysis of the adoption process of cloud computing services, while pursuing the validation of a new model of adoption that would respond to the challenges raised by the field of digital economy.

## Research Objectives

One of the founders of the U.S. automobile industry, Henry Ford (1863 - 1947), referring to the secret of his achievement, said: "Before everything else, getting ready is the secret of success." Given this statement, we believe that the secret of the success of a business is that the organization should be prepared and have, at the right time, all the necessary means to thrive on an increasingly dynamic market, where online presence has become mandatory. In other words, we will try to show in this paper what it means for the SMEs to make the shift toward cloud computing beyond the theoretical concept and the strong marketing campaign waged by cloud providers.

The primary objectives we aim to meet in this paper are the following:

- analyzing the dynamics of the SMEs sector in the current context, economically and technologically determined;
- presenting the specific concepts that characterize the cloud computing phenomenon and all the necessary steps that an organization must follow in order to shift toward cloud;
- proving the necessity of adopting cloud computing-based solutions within SMEs;
- creating an adoption model of the cloud computing solutions within SMEs;
- assessing the level of awareness and implementation of cloud computing services within SMEs from Romania, by conducting a comprehensive study dedicated to this field;
- promoting cloud computing among SMEs by implementing an information-sharing web platform.

## Abstract

**The first chapter**, entitled "**The SMEs profile in the 21st century**" consists of an analysis of the SMEs sector in the context of an increasingly dynamic world. It also focuses on an in-depth examination of the concept of SME, considering its different meanings and the determinant factors involved in developing this kind of organizations. We successively approached topics such as the concept analysis, a study of its characteristics and the presentation of relevant statistical information regarding SMEs. The Romanian perspective within this sector is also treated. In a world dominated by technology, SMEs need to adapt and change their behavior, while rethinking the classification criteria. Under these circumstances, we suggested a new set of criteria for their classification.

Although SMEs have widely adopted information technologies, their access to ICT is still quite limited. Therefore, we tried to identify some specific items of information technologies within these organizations: the role of information technology, the

information system architecture within SMEs, as well as the main categories of ICT tools which are used.

The outsourcing option of IT services looks increasingly attractive and has gained supporters among SMEs due to the associated positive aspects: low cost, quality and flexibility, to name just a few. Thus, we considered necessary to provide an overview regarding the way SMEs see outsourcing. A subsection of this chapter sketches the profile of the SMEs willing to migrate towards cloud, based on the value chain suggested by Porter.

A special section of this chapter provides a comparative analysis between the traditional SME, based on old-fashioned technologies and whose purpose is to survive, and the modern one, which focuses on the latest technologies and is leading a constant struggle for growth and expansion, beyond local borders.

The end of this chapter discusses several key aspects characterizing the SMEs behavior and their future, considering the changes triggered by technological development.

Given the main trends of SMEs behavior mentioned in the final sections of Chapter 1, the next chapter approaches the new way to deliver technology: cloud computing. Therefore, **Chapter 2**, "**Cloud computing – a new "collectivisation" for the information technology**" browses successively through all the important aspects concerning cloud computing: definition of the concept, an analysis of the cloud computing services market, cloud services classification and an overview of the main advantages and disadvantages brought to the organizations by CC. Since risks are very important to analyze when it comes to cloud computing, a subsection of this chapter deals with risk assessment.

Lately, "technology as a service" has become an increasingly promoted business model that is widely accepted all over the world. In the recent years, the effect was amplified by the explosion of offers in cloud computing services.

"**Low cost" information systems in the SMEs sector through cloud computing**" is the subject matter of **Chapter 3** of this paper. It describes how SMEs can make the transition from the traditional IT infrastructure to cloud computing services. Constantly

seeking the best solutions, both at the technological and the economic level, SMEs have become the main target of cloud computing providers. The first part of this chapter describes the changes brought by cloud computing among SMEs from an economic point of view. We also identified and suggested a simplified model to assess the total cost of the ownership, showing that the transition from fixed costs to variable costs "OpEx vs CapEx" does not only bring benefits. In addition to the financial side, we also addressed the question of the access to the latest technologies, traditionally inaccessible to SMEs until now.

One of the most important issues to discuss when it comes to shifting to cloud in the case of SMEs is that these organizations do not have the skills or the resources to properly analyze the phenomenon. Thus, we considered necessary to present the factors behind the CC adoption within SMEs, in our own perspective. Given the main elements underlying the adoption of cloud services among SMEs and the Technology Acceptance Model, we suggested a model for the cloud services adoption within SMEs.

In another section we stated that the Service Level Agreement (SLA) represents the guarantee of the fact that the service provider offers what SMEs expect from him at the agreed price. This brings us to another issue addressed in this chapter, namely the importance of the SLA from a SME perspective. We have emphasized the critical issue of understanding, defining, establishing and negotiating SLAs.

In the final chapter, we present the main hidden costs of cloud adoption among SMEs, while providing some recommendations for avoiding them.

**Chapter 4, "Romanian small and medium-sized enterprises in cloud computing"** represents entirely our personal contribution brought to the field of cloud computing services, with reference to SMEs from our country. This chapter is structured along two axes: the awareness and the implementation of cloud services within SMEs in Romania, by:

- developing an online platform dedicated to the cloud computing phenomenon, underlining the elements which are specific for the SMEs in Romania;
- conducting a study intended to grasp the level of awareness and of cloud computing services adoption within SMEs in Romania.

If up to this point we analyzed the theoretical aspects of the implications cloud computing services have among SMEs, in this chapter we focus our attention on what is happening in the SME sector in Romania with regard to cloud computing. A first observation is that managers of small and medium enterprises are not fully aware of this phenomenon.

The Technology Acceptance Model is frequently used in scientific research and its validation on the Romanian market – SMEs sector – can become a starting point for an expansion of research interests and especially for conducting a series of comparative studies, taking into account other matters too.

Empirical research aimed primarily at identifying an answer to the research problem, namely to define the relationship between the perceived usefulness, the perceived user-friendliness, plus the perceived security risk, and the intention of adoption.

Using structural equation modeling we have been able to test the TAM and check how the hypotheses are confirmed or not. The main hypothesis of the research – there is a significant influence of the perceived usefulness, the perceived user-friendliness and the perceived security risk on the intention of adoption – is just partially confirmed, only the first two proving to have a significant influence.

## Conclusions and personal contributions

SMEs represent the most part of the registered enterprises worldwide, contributing significantly to the economic development. Their importance, both worldwide and within our country, was based on the analysis of various statistical data provided by the

main organizations and entities in charge with the management of this sector.

In today's economic context, marked by restricting economic activities, efficient use of new technologies in SMEs is essential. Unlike large companies that have the resources to innovate or acquire new technologies, SMEs are more oriented towards a survival type of strategy. Cloud computing tends to change the behavior of survival. In the context of a digital economy, where many changes tend to occur, both at the micro and macroeconomic level, cloud computing leans towards becoming the support for these changes, as one of the main factors that may underlie the growth of small businesses by offering them access to the global markets, as well as resources that were unreachable until now, mainly due to their cost.

The new conditions, especially the development of a certain phenomena such as cloud computing and social networks, have created the need for a new approach of the concept by the SMEs. Therefore, *the criteria for classifying SMEs suggested* in this paper are intended to provide a new perspective on the way they are being perceived.

The comparative analysis between the traditional and the modern SME comes to enhance the importance of cloud services within SMEs. This type of enterprises evolve from companies that only wish to survive into companies that lead a constant struggle to grow and expand beyond local boundaries.

The SMEs sector has become the main target of cloud providers, based on two types of reasons: *technological* ones (a simplified structure and lack of resources) and *economic* ones (large number and high share in the economy field).

From constructions to retail, SMEs start to adapt to the cloud phenomenon, while seeking to meet the standards of conformity, security and performance which usually characterize a mature technology. Nevertheless, instead of an adventure towards cloud computing, we notice a cautious approach and the use of cloud computing services especially for secondary functions within SMEs. Distrust and lack of awareness concerning this phenomenon

are two of the factors underlying the yet high degree of reticence with regard to cloud computing.

Most industries use cloud computing for support functions, but necessary ones. Financial organizations, insurers and retailers use it for email and other business support functions (such as sales and support services, collaboration, files management and web conferencing).

Cloud service providers promise reliable resources that are easy to configure, immediately available to consumers and with a minimum input of resources on behalf of the consumers. The issue concerning the advantages and disadvantages is a very topical subject, but unfortunately things are a little unbalanced. We found out that there is a wave of promoted benefits coming from cloud providers up to prestigious companies whose object of activity consists of studies led on information technology.

By means of a *market analysis* we tried to examine some objective elements, combining the existing studies analysis with our own perspective, beyond the inflation of marketing studies and presentations that highlight only the positive factors. In the year of 2013 we cannot yet speak of a mature market, but rather of a booming one. The level of cloud computing services adoption is closely related to the level of economic development.

Besides analyzing the changes brought by cloud computing from an economic point of view, we have also identified and suggested *a simplified model* for assessing the total cost of the ownership. We pointed out that the cloud model is overrated in the SME sector in terms of financial benefits; the "Pay-as-you-go" concept, supported by more or less elaborated demonstrations based on the idea of "OpEx vs CapEx", does not only bring benefits. In addition to the financial side, we also approached the question of access to the latest technologies as one of the main arguments for cloud computing adoption among SMEs.

The cloud computing services providers argue that one of the main problems is that potential customers, in this case SMEs, are companies that do not have IT skills and resources. Thus, we considered necessary to direct our attention to the factors that lie

beneath the cloud computing adoption within SMEs, presenting our own perspective: internal, external and cloud computing features. Considering the main factors underlying the adoption of cloud services among SMEs and the Technology Acceptance Model, we have suggested a model for the adoption of cloud services within SMEs, which reflects our vision. This model is based on both *psychological factors* (the perceived user-friendliness, the perceived usefulness and the perceived risk) and *objective factors* related to the cloud computing adoption among SMEs: internal, external and cloud computing features. The model was also grounded on the *self-adjustment* mechanism taken from cybernetics, necessary for cloud-based systems both for the prevention of problems (*feed-before*), by which self-adjustment would take place before the actual adoption and after the adoption itself (*feed-back*) in order to correct any problems that may have arisen.

The *Service Level Agreement (SLA)* represents the guarantee of the fact that the service provider offers what SMEs expect from him at the agreed price. It is very important for the SMEs to understand, define, establish and negotiate SLAs, although reality shows that there is no openness on the side of the providers with regard to cloud computing supply contracts.

*Hidden costs* are one of the problems increasingly often mentioned in the business environment. Rushing to move to low-cost IT services furthermore besieged with only with positive aspects from cloud providers, SMEs do not consider all the implications related to costs.

Although the Romanian cloud computing services market is incipient, several large groups of services offered by some prestigious providers have already begun to take shape. Cloud services are becoming increasingly popular among SMEs too. As shown in *this study* most companies manage their IT infrastructure by themselves, a fact that can easily lead to its loss or ineffective use. Cloud adoption within SMEs is on an upward trend, but we believe that presently the concept is not sufficiently comprehended and SMEs cannot quantify the potential benefits of cloud computing.

If within countries with advanced economies cloud computing has long become a reality, in Romania, this type of services does not still enjoy a lot of popularity among companies.

All the data obtained in our study indicate that cloud services are becoming increasingly popular among Romanian SMEs. The Romanian market is still immature. Nevertheless, CC adoption is quick and cloud-based solutions will become increasingly important in the coming years. SMEs have a rather reserved attitude when it comes to cloud, while the percentage of companies that intend to transfer their applications to cloud in the next 12 months is very low (around 11%).

Using structural equation modeling, we have been able to test the model and check how the hypotheses are confirmed or not. The main hypothesis of the research – there is a significant influence of the perceived usefulness, the perceived user-friendliness and the perceived security risk on the intention to adopt cloud computing – is just partially confirmed, only the first two proving to have significant influence.

Through the present research we applied and validated the TAM model for cloud services on the Romanian market, the SMEs sector. SEM analysis (CFI-.953, IFI-.0954, RMSEA - 0.075 and SRMR - .0529) suggests that the TAM model is in compliance with the data, it is valid and reliable. The security risk added to the TAM model proved to have no significant connection to the variables in the TAM model. Instead, variables, the perceived usefulness and the perceived user-friendliness from the TAM have a significant influence on the intention of adopting cloud services.

With regard to *limits*, firstly we may speak of using new scales, relatively slightly employed in research. Also, managers are likely to be considered experienced consumers concerning the cloud computing, which makes their use as subjects to be a possible source of error. Another limitation of the research is that we could not measure the actual behavior of managers and we could not verify that after reaching a certain level of utility or user-friendliness, they will contract out cloud services.

Also, in terms of future research *directions*, we mention the following: developing new specific scales measuring TAM variables specific to cloud computing, a research on a representative sample, validating a model that would take into account all the factors concerning the adoption, as well as carrying out comparative studies on different countries.

Although the idea that we are witnessing a "new" IT democratization is widely spread, as well as the universal access to resources up to now dedicated exclusively to those benefiting from considerable budgets, we believe that we are witnessing, on the contrary, a "new" collectivization, a dependence on others' resources that is increasingly promoted. The cloud computing concept is often assimilated with the revolution of low-cost IT resources which can be bought by almost any company, the danger of dependence being overshadowed.

Despite the progress from the recent years, we still have a lot of work ahead us before we can talk of a generalized global phenomenon. SMEs are skeptical with regard to cloud computing, they lack models of implementation that would guarantee them the success of the adoption, while the present risks have still a high share in making a decision. Nevertheless, the future appears to be in the "clouds", but "the clouds are still in the dark".

| Chapter | List of personal contributions |
|---|---|
| **THE SMEs PROFILE IN THE 21st CENTURY** | • Analysis of the current situation of SMEs<br>• New classification criteria for the SMEs<br>• SMEs: between the traditional and the modern<br>• Trends regarding the SMEs development<br>• The SMEs profile in cloud |
| **CLOUD COMPUTING – A NEW "COLLECTIVISATION" FOR THE INFORMATION TECHNOLOGY** | • The need for cloud – triggering factors<br>• Cloud services typology<br>• Cloud computing market analysis: current stage, a model regarding the maturity of the cloud services market |
| **"LOW COST" INFORMATION SYSTEMS IN THE SMEs SECTOR THROUGH CLOUD COMPUTING** | • Categories of specific factors concerning the adoption of cloud computing within SMEs<br>• A cloud computing adoption model within SMEs<br>• Cloud costs: trends, typology, a simplified calculator<br>• Cloud traps and their quantification |
| **ROMANIAN SMALL AND MEDIUM-SIZED ENTERPRISES IN CLOUD COMPUTING** | • The creation of a portal for the SMEs<br>• Online study : validation of the model and presentation of Romanian SMEs perception with regard to cloud computing |

## Bibliography

Our research was based on 200 bibliographical sources divided into several categories, as follows:

- 25 scholarly books and papers
- 35 reports, standards and legislation
- 66 articles
- 74 web resources